

REMARKS

This is a full and timely response to the non-final Office Action mailed by the U.S. Patent and Trademark Office on December 1, 2005. Claims 1-21 remain pending in the present application. Claims 1, 9-11, 12 and 20-21 are amended. Applicants respectfully submit that support for the amendments to claims 1, 9-11, 12 and 20-21 can be found in the specification at least on page 12, line 17. In view of the foregoing amendment and following remarks, reconsideration and allowance of the present application and claims are respectfully requested.

Rejections Under 35 U.S.C. §102

Claims 1-6, 8, 10, 12-17, 19 and 21 stand rejected under 35 U.S.C. §102(e) as allegedly being anticipated by “High Performance InP/GaAsSb/InP DBHTs With Heavily Doped Base Layers” by C. R. Bolognesi *et al.* (hereafter *Bolognesi*). A proper rejection of a claim under 35 U.S.C. §102 requires that a single prior art reference disclose each element of the claim. *See, e.g., W.L. Gore & Assoc., Inc. v. Garlock, Inc.*, 721 F.2d 1540, 220 USPQ 303, 313 (Fed. Cir. 1983). Anticipation requires that each and every element of the claimed invention be disclosed in a single prior art reference. *See, e.g., In re Paulsen*, 30 F.3d 1475, 31 USPQ2d 1671 (Fed. Cir. 1994); *In re Spada*, 911 F.2d 705, 15 USPQ2d 1655 (Fed. Cir. 1990). Alternatively, anticipation requires that each and every element of the claimed invention be embodied in a single prior art device or practice. *See, e.g., Minnesota Min. & Mfg. Co. v. Johnson & Johnson Orthopaedics, Inc.*, 976 F.2d 1559, 24 USPQ2d 1321 (Fed. Cir. 1992). The test is the same for a process. Anticipation requires identity of the claimed process and a process of the prior art. The claimed process, including each step thereof, must have been described or embodied, either expressly or inherently, in a single reference. *See, e.g., Glaverbel S.A. v. Northlake Mkt'g & Supp., Inc.*, 45 F.3d 1550, 33 USPQ2d 1496 (Fed. Cir. 1995). Those elements must either be inherent or disclosed expressly. *See, e.g., Constant v. Advanced Micro-Devices, Inc.*, 848 F.2d 1560, 7 USPQ2d 1057 (Fed. Cir. 1988); *Verdegaal Bros., Inc. v. Union Oil Co.*, 814 F.2d 628, 2 USPQ2d 1051 (Fed. Cir. 1987). Those elements must also be arranged as in the claim. *See, e.g., Richardson v. Suzuki Motor Co.*, 868 F.2d 1226, 9 USPQ2d 1913 (Fed. Cir. 1989); *Carella v. Starlight Archery & Pro Line Co.*, 804 F.2d 135, 231 USPQ 644 (Fed. Cir. 1986). For anticipation, there must be no difference between the claimed invention and the reference disclosure, as viewed by a person

of ordinary skill in the field of the invention. *See, e.g., Scripps Clinic & Res. Found. v. Genentech, Inc.*, 927 F.2d 1565, 18 USPQ2d 1001 (Fed. Cir. 1991).

Accordingly, the single prior art reference must properly disclose, teach or suggest each element of the claimed invention.

It is alleged in the Office Action that

[r]egarding claims 1, 8, 10, 12, 19 and 21, the reference discloses in figure 1, a heterojunction bipolar transistor (HBT) comprising:
a collector;
an emitter; and

a base located between the collector and the emitter, the base including a layer of gallium arsenide antimonide (GaAsSb) (see page 13, the last paragraph) less than 49 nanometers (nm) thick. The reference also discloses base doping concentration of 1×10^{19} and the base is carbon doped (see the cited portion of the paper).

Regarding claims 2-6 and 13-17, the reference discloses arsenic fraction in a range from about 50% to about 51%; about 50% to about 60%; about 54% to about 56%; and approximately 55% (see the above noted section of the reference).

Bolognesi discloses an InP/GaAsSb/InP heterojunction bipolar transistor having a base layer doped to a maximum doping concentration of 2.5×10^{20} acceptors per cm^{-3} . Specifically, *Bolognesi* states "C-doped GaAsSb base layers are essentially free of H-passivation effects and can be doped to levels as high as $2.5 \times 10^{20} \text{ cm}^{-3}$ while maintaining hole mobilities of at least $\mu_p = 25-30 \text{ cm}^2/\text{Vs}$ for extremely low base sheet resistances." *See Bolognesi, Abstract.* *Bolognesi* continues stating "[a]t this time we have still not made use of the full range of base doping levels available to us (up to $2.5 \times 10^{20}/\text{cm}^3$) but used conservative base doping levels of $0.8-1.0 \times 10^{20} / \text{cm}^3 \dots$." *See Bolognesi, page 14.*

In marked contrast to *Bolognesi* the present invention includes a heavily doped base layer of GaAsSb, doped to a concentration greater than 2.5×10^{20} acceptors / cm^3 .

Specifically, and with particular regard to the claims, independent claim 1 includes at least "a base located between the collector and the emitter, the base including a layer of gallium arsenide antimonide (GaAsSb) less than 49 nanometers (nm) thick and having a doping concentration greater than 2.5×10^{20} acceptors/ cm^3 ." Similarly, independent claim 12 includes at least the step of "forming a base located between the collector and the emitter, the base including a layer of gallium arsenide antimonide (GaAsSb) less than 49 nanometers (nm) thick and having a doping concentration greater than 2.5×10^{20} acceptors/ cm^3 ."

Applicants respectfully submit that *Bolognesi* fails to disclose, teach or suggest these features.

Accordingly, Applicants respectfully submit that claims 1 and 12 are allowable over

Bolognesi. Further, Applicants respectfully submit that claims 2-6, 8 and 10, which depend from allowable claim 1, and dependent claims 13-17, 19 and 21, which depend from allowable claim 12, are allowable for at least the reason that they depend from an allowable independent claim. *In re Fine*, 837 F.2d 1071, 5 U.S.P.Q.2d 1596, 1598 (Fed. Cir. 1988) (citations omitted).

Rejections Under 35 U.S.C. §103

Claims 7, 11 and 18

Claims 7, 11 and 18 stand rejected under 35 U.S.C. §103(a) as allegedly being unpatentable over *Bolognesi*. For a claim to be properly rejected under 35 U.S.C. §103, “[t]he PTO has the burden under section 103 to establish a *prima facie* case of obviousness. It can satisfy this burden only by showing some objective teaching in the prior art or that knowledge generally available to one of ordinary skill in the art would lead that individual to combine the relevant teachings of the references.” *In re Fine*, 837 F.2d 1071, 5 U.S.P.Q.2d 1596, 1598 (Fed. Cir. 1988) (citations omitted). Further, “[t]he mere fact that the prior art may be modified in the manner suggested by the Examiner does not make the modification obvious unless the prior art suggested the desirability of the modification.” *In re Fritch*, 972 F.2d 1260, 1266, 23 U.S.P.Q.2d 1780 (Fed Cir. 1992).

Claims 7, 11 and 18

It is stated in the Office Action that

[t]he primary reference discloses the claimed invention, as discussed above, except for expressly disclosing the base is less than 20 nm thick. It would have been obvious to one ordinary skill in the art at the time of the invention to make the base less than 20 nm thick, since the prior art has a 20 nm thick base, which is negligibly close to a base of less than 20 nm thick.

With regard to claim 11, and as stated above, *Bolognesi* fails to disclose, teach or suggest base doping concentrations above $2.5 \times 10^{20} / \text{cm}^3$. Accordingly, Applicants respectfully submit that *Bolognesi* fails to anticipate Applicants claim 11, which states “wherein the base layer of GaAsSb is doped with carbon (C) at a doping concentration of between 2.5×10^{20} and 4×10^{20} acceptors/cm³.”

Further, for at least the reasons stated above, Applicants respectfully submit that *Bolognesi* fails to disclose, teach or suggest each element in independent claims 1 and 12. Accordingly, Applicants respectfully submit that dependent claims 7, 11 and 18 are allowable for at least the reason that they depend, either directly or indirectly, from allowable

independent claims. *In re Fine, supra.*

Claims 9 and 20

Claims 9 and 20 stand rejected under 35 U.S.C. §103(a) as allegedly being unpatentable over *Bolognesi* and further in view of U.S. Patent No. 5,349,201 to *Stanchina et al.* (hereafter *Stanchina*).

It is stated in the Office Action that

Stanchina discloses at column 3, lines 39-47, an HBT with Be doped GaAsSb base layer provides improved performance over conventional HBTs by increasing the hole mobilities and valence band offset. Therefore, it would have been obvious to one of ordinary skill in the art at the time of the invention to use this material in the HBT structure of the primary reference to increase the performance of the structure.

Stanchina discloses a heterojunction bipolar transistor (HBT) that includes a base layer that is preferably 65 nanometers (nm) thick. Specifically, in a preferred embodiment, *Stanchina* requires that the base layer 16 includes a 50 nm thick main layer 16a doped with beryllium (Be) to a free carrier concentration of approximately 3 to 6×10^{19} holes/cm³, with the preferred value being 5×10^{19} , and a spacer layer 16b disposed between the main layer 16a and the collector layer 14. The spacer layer 16b is preferably 15 nm thick, and doped with beryllium to a free carrier concentration of 2×10^{18} holes/cm³ (see column 3, lines 29-38). Specifically, *Stanchina* requires a base thickness of at least 65 nm.

Applicants respectfully submit that the base doping concentration of between 2.5×10^{20} and 4×10^{20} acceptors/cm³ is the salient feature of claims 9 and 20 and not the base dopant. Applicants respectfully submit that the proposed combination fails to disclose, teach or suggest base doping using Be at a concentration of between 2.5×10^{20} and 4×10^{20} acceptors/cm³ as recited in claims 9 and 20.

No Motivation to Combine *Bolognesi* with *Stanchina*

Applicants respectfully submit that there is no motivation to combine *Bolognesi* with *Stanchina* to arrive at the present invention.

Applicants respectfully submit that there is nothing in *Bolognesi* and *Stanchina* that would motivate one having ordinary skill in the art to combine these references to arrive at the base doping concentration recited in claims 9 and 20. Further, the proposed combination fails to provide either a reasonable expectation of success of combining the references to

achieve the invention, or show any relevance to the problem solved by Applicants' invention. Further, the Office Action fails to articulate a clear motivation to make the proposed combination.

Specifically, Applicants respectfully submit that the Office Action fails to establish a *prima facie* case of obviousness because the Office Action has not pointed out the specific teachings in *Bolognesi* and *Stanchina* that would motivate one having ordinary skill in the art to combine the references to arrive at Applicants' invention. Indeed, neither *Bolognesi* nor *Stanchina* disclose, teach or suggest the doping concentration recited in claims 9 and 20. Indeed, *Bolognesi* refers to a maximum based doping concentration of $2.5 \times 10^{20} / \text{cm}^3$ and further states that “[a]t this time we have still not made use of the full range of base doping levels available to us (up to $2.5 \times 10^{20}/\text{cm}^3$) but used conservative base doping levels of $0.8\text{--}1.0 \times 10^{20} / \text{cm}^3 \dots$ ” *See Bolognesi*, page 14.

Further, Applicants respectfully disagree with the conclusory statement in the Office Action that

[t]herefore, it would have been obvious to one of ordinary skill in the art at the time of the invention to use this material in the HBT structure of the primary reference to increase the performance of the structure.

Applicants respectfully submit that one having ordinary skill in the art would not be led toward the claimed doping concentrations because neither *Bolognesi* nor *Stanchina* suggests the base doping concentration recited in claims 9 and 20.

For at least the reasons stated above, Applicants respectfully submit that the proposed combination is improper, and further, that the proposed combinations fail to disclose, teach or suggest the all elements of the invention

For at least the reasons stated above, Applicants respectfully submit that the proposed combination fails to disclose, teach or suggest each element in dependent claims 9 and 20. Furthermore, Applicants respectfully submit that dependent claims 9 and 20 are allowable for at least the reason that they depend from allowable independent claims 1 and 12, respectively. *In re Fine, supra.*

CONCLUSION

For at least the foregoing reasons, Applicants respectfully request that all outstanding rejections be withdrawn and that all pending claims of this application be allowed to issue. If the Examiner has any comments regarding Applicants' response or intends to dispose of this matter in a manner other than a notice of allowance, Applicants request that the Examiner telephone Applicants' undersigned attorney.

Respectfully submitted,

Smith Frohwein Tempel Greenlee Blaha LLC
Customer No. 35856

By:



Michael J. Tempel
Registration No. 41,344
(770) 709-0056